



Standard Specification for Vacuum Treated Steel Forgings, Alloy, Differentially Heat Treated, for Turbine Rotors¹

This standard is issued under the fixed designation A 940; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers vacuum treated, alloy steel forgings, differentially heat treated for turbine rotors.

1.2 Differential heat treatment of a rotor forging involves subjecting two portions of the forging concurrently to two different austenitizing temperatures followed by two different cooling rates for normalizing and quenching, and then tempering, to achieve creep resistance in the high pressure (HP) portion and high toughness in the low pressure (LP) portion.²

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

A 275/A 275M Test Methods for Magnetic Particle Examination of Steel Forgings³

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products³

A 418 Test Method of Ultrasonic Examination Inspection of Turbine and Generator Steel Rotor Forgings³

A 470 Specification for Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts³

A 472 Test Method for Heat Stability of Steam Turbine Shafts and Rotor Forgings³

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products⁴

A 788 Specification for Steel Forgings, General Requirements³

E 139 Practice for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials⁵

3. Ordering Information

3.1 In addition to the ordering information required by Specification A 788, the purchaser shall include with the

inquiry and order a detailed drawing, sketch, or written description of the forging, including the mechanical test locations, the portion of the forging to be included in the heating chamber during the stability test, and the minimum stability test temperature.

3.2 The purchaser shall specify if check tests for mechanical properties are required after stress relief or heat stability tests.

3.3 *Supplementary Requirements*—Supplementary requirements are provided. These requirements shall apply only when specified in the purchase order.

4. General Requirements

4.1 Material supplied to this specification shall conform to the requirements of Specification A 788, which outlines additional ordering information, manufacturing requirements, testing and retesting methods and procedures, marking, certification, product analysis variations, and additional supplementary requirements.

4.2 If the requirements of this specification are in conflict with the requirements of Specification A 788, the requirements of this specification shall prevail.

5. Manufacture

5.1 Melting processes of Specification A 788 shall be applicable, except that the open hearth or basic oxygen methods of primary melting shall not be used and the molten steel shall be vacuum treated during processing. When the ladle degassing process is used, the evacuation system shall be capable of reducing the system vacuum pressure to a low level (usually less than 1000 μm). The molten metal shall be stirred adequately for a sufficient length of time to maximize exposure to the evacuated atmosphere. When this process is used, hydrogen testing per Supplementary Requirement S4 is mandatory.

5.1.1 If the ESR process is used, the electrodes shall have been produced from vacuum treated primary heat(s), and Supplementary Requirement S4 is mandatory.

5.2 In addition to the requirements of Specification A 788, it is important to maintain the axial center of the forging in common with the axial center of the original ingot.

5.3 *Differential Heat Treatment*—The heat treatment for mechanical properties shall consist of normalizing and tempering of the creep resistant portion, HP portion, and quenching and tempering of the high toughness portion, LP portion.

5.3.1 The preliminary heat treatment shall consist of normalizing well above the transformation temperature range.

¹ This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.06 on Steel Forgings and Billets.

Current edition approved Sept. 10, 1996. Published July 1997. Originally published as A 940-95. Last previous edition A 940-95.

² *Symposium on Steel Forgings, ASTM STP 903*, ASTM, Philadelphia, PA, 1984, pp. 59-86.

³ *Annual Book of ASTM Standards*, Vol 01.05.

⁴ *Annual Book of ASTM Standards*, Vol 01.03.

⁵ *Annual Book of ASTM Standards*, Vol 03.01.